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ON CERTAIN CONTRIVANCES FOR CROSS-FERTILIZATION IN FLOWERS.

BY PROF. J. E. TODD.

SINCE the first announcement of the principle of cross-fertilization, by Darwin, many most interesting and instructive examples have been noted and published, but the field is by no means exhausted.

Some ingenious contrivances for cross-fertilization are charmingly described by Prof. Gray in his little work "How Plants Behave," which he published a few years since as earnest of a larger work, which, we hope, may be soon forthcoming. One as wonderful as any is the Iris. His description applies nearly equally well to any species of that beautiful genus. His figure, perhaps, is open to slight criticism; the pistil is too erect and the stigma, therefore, too high above the sepal to illustrate its function to the best advantage. The position given is sometimes observed after the pistil is fertilized, but before that the pistil turns down so close to the sepal that a large bee in entering *must* touch the stigma with his back, which has been powdered with pollen while working in some previously visited flower (Fig. 1). Not stopping, however, to repeat what has been so well stated before, I would simply call attention to one point which I think is worthy of mention, viz: the plush-like "crest" of the

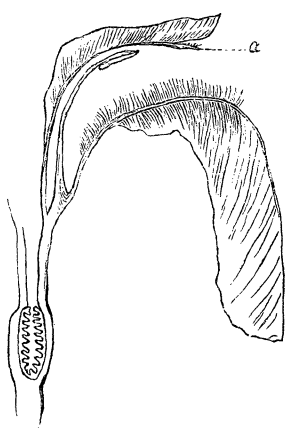

FIG. 1.—A section of portion of an Iris flower. *a*, stigma.

sepal. Is it not well adapted for tripping the smaller insects, or raising them, so that they shall hit the stamen and stigma, forcing them by increased activity, or by their walking on its top, to compensate for lack of size? In this arrangement of parts in the Iris we have the main features of a plan which is traceable in many other flowers.

Strangely enough many *irregular monopetalous* corollas seem to copy this *regular polypetalous* one in its method of cross-fertilization. This is especially true of *Martynia proboscidea* Glox., the unicorn plant. The general form and structure of the flower is shown in the figures. The lower petal forms a broad platform upon which the bee alights. As it enters the tube (which I believe is broader before fertilization, the roof rising as the corolla fades), it first brushes the lower lip of the stigma, Fig. 3 *a*, then while getting the nectar at the bottom of the tube its back is dusted by the anthers. As it withdraws, the flexible lobe of the pistil, like a valve, allows the pollen to pass without touching the stigma, which is on its upper or inner surface. This lower lobe is very sensitive before fertilization, during which time it hangs nearly vertical. In the case of a flower kept for examination, as soon as it was touched with a mass of pollen it rose toward the upper lobe so rapidly that its motion was very perceptible.

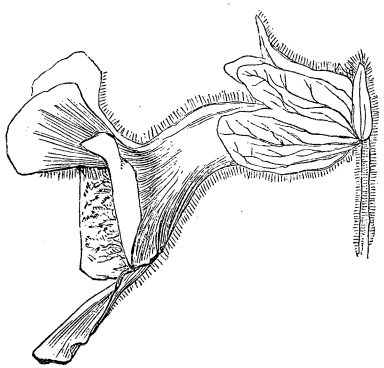

FIG. 2.—Side view of *Martynia proboscidea*. (Natural size.)

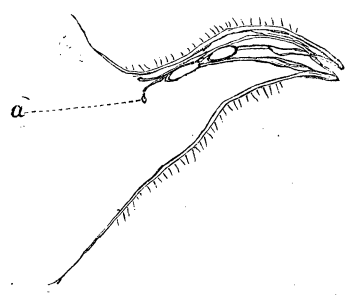

FIG. 3.—Cross-section of *Martynia proboscidea* showing arrangement of pistil and stamens. *a*, flexible lobe of stigma as before fertilization.

In the Penstemons (my observations are mainly upon one species, *P. glaucus* [?] Grah.[1]), we

[1] The notes presented were made last June on a species occurring abundantly in Central Nebraska. The species was not familiar to me: I made a hasty sketch of the flower as given. Certain notes of the characters of the plant were taken, but not enough to decisively distinguish it from the many species of the same genus occurring in that region.

have another slight variation of the plan. The corolla tube is broad and large. On the upper side are the four anthers in two pairs, and above them, or back of them, the pistil with undivided stigma. Before the anthers discharge their pollen the style is straight lying close to the upper side of the tube. While the pollen ripens and is discharging, the style elongates, and its end, after passing the longer stamens, turns abruptly downward. This position is not usually taken till the pollen is all gone from the flower. This arrangement brings the stigma right in the way of any insect entering the flower, and scrapes from it the pollen it may have received from some neighboring flower in which the stamens are discharging pollen.

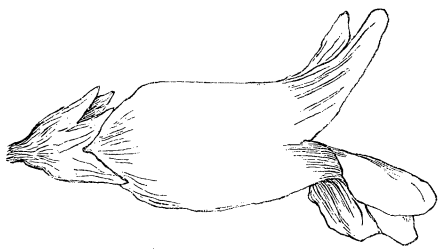

FIG. 4. — *Penstemon glaucus* (?). Side view. (Natural size.)

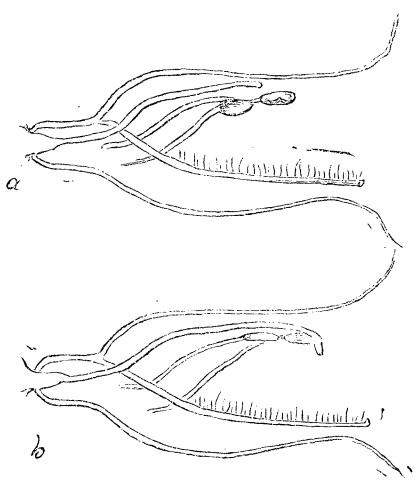

FIG. 5.—Cross-sections of the same. *a*, staminate stage; *b*, pistillate stage.

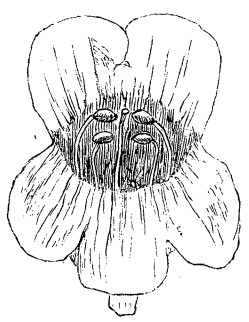

FIG. 6.—Front view of the same after discharge of pollen.

The following table, showing relative development of pistil and stamens in *P. glaucus*, gives full authority for the above statements:

	Anthers discharged.	Partly discharged.	Closed.
Pistils straight.....	0	7	27
" curved	21	17	1

It is to be regretted that the degree of curvature of the pistil was not more carefully noted; it may be said, however, that

generally it was considerably less when the pollen was partially discharged, than when it was entirely discharged.

We see very clearly, therefore, how the later development of the pistil with the curving of the style in this case accomplishes the same end as the flexible bi-lobed stigma placed in front of the stamens, as in the *Martynia*.

It is very interesting to find in the lower side of the tube, in the Penstemon, the fifth stamen, which is sterile and *bristling* with hairs, serving the same purpose, apparently, as the crested sepal in the Iris.

In the *Gladiolus* a relation of pistil to stamens is found similar to that in the Penstemon, while in several of the *Labiatæ* we find both the valve-like arrangement of the stigma and the later lengthening and bending of the style.

In *Lobelia syphilitica* L., as probably in all the Lobelias, we find a very different arrangement, but accomplishing the same result, viz: cross-fertilization of the plant.

The corolla is monopetalous and two-lipped, the lower lip consisting of three petals and the upper of two. Between the latter is a slit extending to the base of the tube. The five stamens are free from the corolla and united, their anthers and upper parts of the filaments forming a tube; or it may be said, the anthers combining, form a common cell for the pollen, which opens by a pore at its apex. On the lower margin of the pore are many short stiff hairs, which at first project across the pore closing it, but when the pollen is ripe they turn abruptly downwards and leave it open. There is only one pistil, which is armed near the end of the style with a collar of short stiff hairs, similar in size and character to those on the anthers just mentioned. The end of the style with its hairs forms the bottom of the pollen-cell before

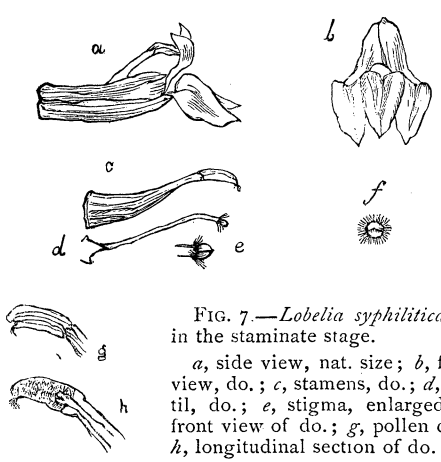

FIG. 7.—*Lobelia syphilitica* L., in the staminate stage.

a, side view, nat. size; *b*, front view, do.; *c*, stamens, do.; *d*, pistil, do.; *e*, stigma, enlarged; *f*, front view of do.; *g*, pollen cell; *h*, longitudinal section of do.

described. We have, therefore, the stigma shut up with the pollen in the same cell. "A capital arrangement for *self*-fertilization," one says. Nay, not too fast! The stigma is composed of two fleshy lobes, its receiving surface being on their inner surface. And they are closed firmly together, so that the end of the pistil looks like a closed mouth with its lips firmly pressed together. With its bristly collar it reminds one of Jack-in-a-box, with an unusually "stiff upper lip."

This combined pistil and stamens is S-shaped, and when the flower opens, it springs through the slit on the upper side of the corolla and stands with the tip of the pollen-cell just behind the upper lip of the corolla, vide Fig. 7 *a*. The front view of the same is given in Fig. 7 *b*. Sometimes there is no trace of the stamens seen from the front; but if an insect tries to enter, the slit between the petals opens, the hairs of the anthers strike his back, and as he forces his way in, they produce a jarring of the pollen-cell which freely sprinkles the pollen upon him.

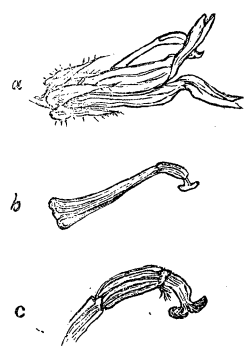

FIG. 8.—*Lobelia syphilitica* in the pistillate stage. *a*, side view, nat. size; *b*, pistil and stamens; *c*, anthers and stigma, enlarged.

As the pollen escapes it is kept up to the pore by the pressure caused by the gradual lengthening of the style. The hairy collar acting like a swab, sweeps the cell clean. When all the pollen is gone, the style, continuing its growth, pushes the stigma through the pore and forward through between the upper petals. The end of the style then comes downward, the lips of the stigma open and roll back as though turning inside out. This exposes the whole surface of the stigma to be covered with pollen from the back of the first insect which comes from a flower discharging pollen. So the cross-fertilization is beautifully accomplished.

These entertaining structures present some very suggestive ideas. We are impressed with the importance of cross-fertilization in the economy of nature, but why it should be of any advantage who can tell? We readily see that in several of these cases cross-fertilization between flowers upon different roots is likely to be quite rare. In *Martynia* such fertilization may be quite frequent, as there are comparatively few flowers open at once, but

in *Gladiolus*, *Penstemon*, *Labiatæ*, etc., there are many flowers on the same root at the same time, presenting the various stages of advancement. The chances are strongly in favor, therefore, of their being fertilized by pollen from flowers on the same root. In the Iris, notwithstanding its elaborate structure to secure cross-fertilization, it is quite probable that a particular pistil will be fertilized by the pollen from a stigma of the *same* flower.

While, therefore, we may admit that these contrivances may be to render a little more frequent the transfer of pollen to ovules on different plants, yet it impresses the thought upon us that each flower (and in the Iris each *third* of what is commonly called a flower) is a distinct vegetable unit. Therefore separate plants, as they are commonly called, like their marine mimics, the Hydroids, would be colonies, composed of hundreds or even thousands of *phytons*.

One more lesson, which we find given in the following admirable words of Prof. Gray:

"Now, no matter whether or not the flowers themselves, with all these structures, have been perfected step by step, through no matter how long a series of natural stages—if these structures and their operations, which so strike the mind of the philosopher no less than of the common observer, that he cannot avoid calling them contrivances, do not argue intention, what stronger evidence of intention in nature can there anywhere possibly be? If they do, such evidences are countless, and almost every blossom brings distinct testimony to the existence and providence of a Designer and Ordainer, without whom, we may well believe, not merely a sparrow, not even a grain of pollen may fall."

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CURIOUS ABORIGINAL CUSTOMS.

BY W. J. HOFFMAN, M.D.

ONE of the most singular and wide-spread customs practiced by the aborigines of North America, was that of cutting off the nose of the woman found guilty of adultery. In a previous article in the NATURALIST,[1] several tribes were referred to as having practiced this mode of mutilation—one or two of them to within recent times. Since the publication of that paper, I have met with various references upon the same subject, which may be of sufficient interest to enumerate. The earliest notice of the

[1] Am. Naturalist, xii, 1878, pp. 560–562.